BTEC Assignment Brief

Qualification	Pearson BTEC International Level 3 Diploma in Construction and the Built Environment Pearson BTEC International Level 3 Extended Diploma in Construction and the Built Environment Pearson BTEC International Level 3 Diploma in Civil Engineering Pearson BTEC International Level 3 Extended Diploma in Civil Engineering Pearson BTEC International Level 3 Diploma in Building Services Engineering Pearson BTEC International Level 3 Extended Diploma in Building Services Engineering
Unit number and title	Unit 17: Further Mathematics in Construction
Learning aim(s) (For NQF only)	B: Examine how calculus can be used to solve a construction problem.
Assignment title	Calculus and numerical integration
Assessor	
Issue date	
Hand in deadline	
Vocational Scenario or Context	You are working as a trainee civil engineer within a medium sized civil engineering consultancy company. Your supervisor has asked you to work on some calculations for you to demonstrate an understanding of how calculus can be used to provide solutions to construction problems.
Task 1	You are going to solve a range of construction industry-related problems using differential calculus, integral calculus and numerical integration. This is heavily reliant on the centre developing tasks, the AAB should incorporate tasks to guide the assessors and learners. Unfortunately, this reads simply as the unit specification. Please add tasks relevant to the targeted criteria. **To do this:** Your tutor will provide you with a range of construction problems to solve. Firstly you will apply the rules of differential calculus to solve the

following:

1. The equation for volume of water (Q), passing through a pipe after a valve has been opened, in time t(s) is:

$$Q = 8t^2 + 4t + 2$$

a) Differentiate the equation to find the functions for velocity ($v = \frac{dQ}{dt}$)

b) Use your result from part a to calculate the velocity of the water at $t = 2\,s$ and $t = 6\,s$.

2. The displacement of a mass is given by the function

$y = \sin 3t.$

The tasks are to:

a) Differentiate the equation to find the function for y
b) Calculate the turning points of the function using differential calculus.

3 The illuminance (E) of a light source is given by the function

$$E = \frac{150}{r^2}$$

Where r is the distance from the light source

a) Differentiate the equation to find the function for illuminance

b) Use the result from part a to calculate $\frac{dE}{dr}$ when r = 2m

4. The estimate population growth for a new development is given by the function

$y = e^{2t+1}$

a) Differentiate the equation to find the function in terms of t

b) Calculate the value of $\frac{dy}{dt}$ when t=4

Then you need to complete the following

The displacement, y(m), of a body in damped oscillation is

$$y=3e^{-2t}\sin 2t$$

c) Use the Product Rule to find an equation for the velocity of the object if $v=\frac{dy}{dt}$.

5. A company is required to fence off the area around a construction site to prevent unauthorised access. They have 1250m of fencing available

Find the maximum area of land they can fence off.

Integration

Next you will use integral calculus to solve a range of construction related problems:

6. The payback rate for a solar installation is represented by the function

$$\frac{dy}{dx}=2x-4x^3+3$$

a) Find the indefinite integral of the function
b) Calculate the amount paid back (y) between x = 1 and x = 4 years.

7. The electrical supply, v, for an air conditioning unit is represented by the function $\frac{dv}{d\theta}=8\sin 3\theta$.

a) Find the indefinite integral of the function
b) Calculate the root mean square (RMS)

Over a range of $0\leq\theta\leq\frac{\pi}{4}$ radians.

[Note the trigonometric identity $\cos 2\theta=1-2\sin^2\theta$*]*

8. The rate at which a tipper truck unloads soil is represented by

the function

$$\frac{dy}{dt}=\frac{3}{t^2+3}$$

a) Find the indefinite integral of the function
b) Calculate the volume of soil unloaded between t = 0 and t = 3 (minutes)

9. The extension, y, of a suspension cable with an applied force, F, is given by $\frac{dy}{dF}=e^{2F}$

a) Find the indefinite integral of the function to find an expression for the work done
b) Calculate the work done if the load increases from 100N to 300N

10. Next you need to find the indefinite integral of the function

$$y=2t^3+2e^{3t}+\frac{2}{3}+2\cos 2t$$

Calculate the definite integral

$$\int_1^4 y=2t^3+2e^{3t}+\frac{2}{3}+2\cos 2t$$

11. Then you will use numerical integration techniques to determine the area under at least two given curves, using each of the following approaches. You then need to compare the results:

- Mid-ordinate rule
- Trapezium rule
- Simpson's rule

Curve one is represented by the equation

$y = 2\cos\Theta - 1$ between $\Theta = 0$ and $\Theta = \pi$ radians (180º)

Curve two is represented by the equation

$y = x^2 - 3x$ between $x = 3$ and $x = 7$

You then need to evaluate the results of your numerical integration, considering how variables could be optimised for differential functions, taking into account variations in results achieved from integration using calculus and numerical methods.

Checklist of evidence required	A report containing the results of calculations; this should include any work carried out under controlled conditions and be supported by text and diagrams as appropriate. You should show all of your working, and make sure that your calculations are clear, giving you answers to an appropriate degree of accuracy, in standard form if necessary, and use the correct units.
Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria you must show that you are able to:
17/B.D2	Demonstrate, using complex differential and integral calculus techniques, the solution for a given construction problem, validating results achieved by numerical integration.
17/B.M2	Demonstrate, using advanced differential calculus, solutions for each type of given routine function, for a given construction problem.
17/B.M3	Demonstrate, using advanced integral calculus and numerical integration, the solution for a given construction problem.
17/B.P2	Demonstrate, using simple differential calculus techniques, the solution for a given construction problem.
17/B.P3	Demonstrate, using simple integral calculus techniques, the solution for a given construction problem.
17/B.P4	Demonstrate, using simple numerical integration techniques, the solution for a given construction problem.
Sources of information to support you with this Assignment	Textbook: Construction & The Built Environment Level 3; S Topliss, M Hurst; Pearson publications; ISBN 08456304444 Weblinks: http://www.mathsisfun.com/index.htm http://www.mathcentre.ac.uk/students/topics Above are some examples of websites. Further useful resources may be found at: qualifications.pearson.com/en/support/published-resources.html
Other assessment materials attached to	n/a

this Assignment Brief	